PATENT SPECIFICATION 664,905

Date of filing Complete Specification : Sept. 14, 1950.

Application Date : Dec. 15, 1949. No. 32190/49.

Complete Specification Published : Jan. 16, 1952.

Index at Acceptance :—Class 85, B4.

COMPLETE SPECIFICATION.

Improvements in and relating to Devices for Centralizing Casing in Boreholes.

I, ALBERT EDWARD ATKINSON, a British Subject of Ditton Edge, 108, Manor Road North, Hinchley Wood, Esher, in the County of Surrey, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to devices for centralizing casing in boreholes in conjunction with well drilling and like operations, of the kind comprising an annular series of bowed springs secured at their ends to spaced rings which are adapted to be fitted to the exterior of the casing so that the bowed portions of the springs can engage the wall of the borehole. The main purpose of such devices is to ensure that the casing occupies a position at or near the centre of the borehole for the introduction of cement between the casing and the wall of the hole. The casing is liable to be subjected to considerable side thrust, for example if the hole is not straight or has a sinuous form, and such may be sufficient to flatten the springs on one side of the casing so that the latter will be eccentrically disposed in the hole. Since the clearance between the wall of the hole and the casing is small, there is a limit to the dimensions of the springs which can be employed and such are usually of standard sizes. It is the object of the present invention to provide an improved device capable of centralizing casing under greater side thrusts than has hitherto been possible, and without substantially increasing the spring dimensions. A further object is to provide a simple, convenient and relatively inexpensive construction which fulfills the above requirements.

The invention consists in a device of the kind described in which the bowed springs are connected to their end rings in such a manner that the bowed spring portions can be initially stressed to increase their resistance to lateral load.

The invention also consists in a device of the kind described in which the bowed springs are formed or provided, at one or both ends, with a mounting extension which in the free condition of the spring occupies a position displaced from its working position on the end ring, so that when in working position, the bowed portion of the spring is initially stressed to increase its resistance to lateral load. Preferably such displaced extensions are provided at both ends of each spring.

The invention further comprises a device according to either of the two preceding paragraphs, in which the bowed springs are connected to the end rings in such a manner that individual relative movement of the springs in the longitudinal direction of the device is prevented. According to a further feature of the invention, the springs comprise a bowed portion and an integral extension at one or both ends which is displaced in the free condition of the spring as previously described and is adapted to be mounted in the end ring so as to stress the spring when the device is applied to the casing. The mounting portion of the extension may be joined to the bowed portion by an outwardly cranked portion to provide a convenient clearance for the usual stop ring secured to the casing and against which the end ring of the device abuts when the casing is displaced in the borehole.

In the accompanying drawing,

Figure 1 is an elevation of a centralizing device constructed according to the invention and mounted on a bore hole casing;

Figure 1*a* is an elevation of one of the springs in free condition;

Figure 2 is an end view of the device;

Figure 3 is an end view of a modified form of device;

Figure 4 is a side elevation of the modified device;

Figure 5 is a side elevation of the inside of one of the connected elements forming the modified device.

In carrying the invention into effect according to one convenient mode as illustrated in Figures 1 and 2, the device comprises an annular series of bowed springs 1 secured at their ends to spaced rings 2 which are fitted to the exterior of the bore hole casing 3 so that the bowed portions of the springs can engage the wall of the bore hole. The rings 2 are positioned on the casing by stop rings 4 which are welded or otherwise secured to the casing in accordance with usual practice. According to the invention, each of the steel springs 1 is formed with a bowed portion 5 having integral end extensions 6 adapted to be connected to the end rings 2 and which extensions 6, in the free condition of the spring, are relatively inclined in such a manner that when brought into alignment when the rings are mounted on the casing, the bowed portion 5 is stressed to increase its resistance to applied load. Figure 1 shows the springs in stressed condition and when free, i.e. when disconnected from the end rings, the extensions 6 will be relatively inclined outwardly with respect to a plane surface upon which the spring is laid as will be clearly seen in Figure 1*a*. It will be seen that when bringing such extensions into alignment as shown in Figure 1, the central portion of the spring is stressed and its outward bowing tends to increase. Each extension 6 is joined to the bowed portion 5 by an outwardly cranked portion 7. The ends of the straight portions 6 are turned outwardly to form lugs 8 which are adapted to enter correspondingly shaped slots 9 in the end rings of the device. The end rings may be formed in any convenient way to receive the spring extensions, the arrangement being such that when the springs are connected to the rings 2 and the device is mounted on the casing 3, the extensions 6 are forcibly brought into alignment or into a position parallel with the longitudinal axis of the device so that the bowed portion 5 is stressed outwardly, and the lugs 8 on the ends of the springs enter the ring slots 9 and thereby prevent relative longitudinal movement of the individual springs. The form of ring shown is built up from curved sections by welding but casting or other suitable methods may be employed. Each ring comprises an inner series of curved sections 10 uniformly spaced so that the ends 6 of the springs may enter between them. These sections are connected by an outer series of curved sections 11 which overlap and bridge the inner sections 10 to which they are welded or otherwise secured, each of said outer sections having a transverse slot 9 to receive the spring lug 8. The sections may be formed from suitably curved plate and the inner sections 10 are longer in the direction of the ring axis than the outer sections 11. A ring built up in this manner will have a castellated cross-section and affords the advantage of a somewhat larger area for fluid flow outside the casing.

The arrangement is such that when the springs are assembled in the rings as described above and the rings are mounted on the casing, each spring bow 5 is initially stressed outwardly by the displacement of its extensions into alignment or into a position approaching alignment, this displacement being effected by the engagement of the inner ends of the extensions (or the outer ends of the bow portion) with the casing to force such portions of the springs apart, and since the outer ends of the spring extensions are held within the rings, this displacement increases the bowing of the spring and affords it initial stress. It will be seen that, in effect, the ends 12 of the bow 5 constitute fulcrums and the extensions 6 act as levers to apply the initial stress, as a result of which the spring bows are capable of resisting a considerably greater load than in their free condition, not only when the load is first applied, but throughout the range of deflection of the bow. Also the mode of connecting the springs to the end rings prevents relative longitudinal motion between the springs and rings, so that no spring can act individually should it alone be subject to stress in passing a kink or obstruction in the hole, such spring being afforded the collective resistance of all the springs in resisting elongation by flattening. The cranked portions 7 at the end of the spring bows afford a convenient clearance for the usual stop rings 4 which are secured to the casing within the end rings of the centralizing device.

Any desired number of springs may be provided, the number generally varying in accordance with the casing diameter. The springs are generally disposed to lie parallel with the axis of the casing, but they may be inclined thereto if desired.

In order to permit the fitting of the device to casing of the kind having enlarged screwed ends, the modified construction shown in Figures 3, 4 and 5 may be adopted. Each ring is split and comprises two halves 13 and 14 which are provided with complementary hinge portions 15 and 16 as shown in Figure 4 and are connected together by pins 17. The ring halves may be formed similarly to the previously described rings and have internal recessed portions 18 to receive the spring extension parts 6 and slots 19 for the lugs 8. The

operation of the modified device is otherwise as described in the previous example.

The invention is not restricted to the mode of connecting the springs to the ring nor to the ring construction described in the above example. Thus in an alternative arrangement, the springs may be permanently secured to the rings in such a manner as to afford the required initial set of the bowed spring portions.

What I claim is:—

1. A device of the kind described in which the bowed springs are connected to their end rings in such a manner that the bowed spring portions can be initially stressed to increase their resistance to lateral load.

2. A device of the kind described in which the bowed springs are provided, at one or both ends, with a mounting extension which in the free condition of the spring occupies a position displaced from its working position on the end ring, so that when in working position, the bowed portion of the spring is initially stressed to increase its resistance to lateral load.

3. A device as claimed in Claim 1 or 2, in which the bowed springs are connected to the end rings in such a manner that individual relative movement of the springs in the longitudinal direction of the device is prevented.

4. A device as claimed in Claim 3, in which the connection between the spring ends or end extensions and the end ring or rings includes a lug or angled portion on the spring or spring extension engaged in an aperture or between abutments on the ring so that individual relative movement of the spring in the longitudinal direction of the device is prevented.

5. A device as claimed in any of the preceding claims, in which the springs comprise a bowed portion and an integral extension at one or both ends which is displaced in the free condition of the spring and is adapted to be mounted in the end ring when the device is applied to the casing.

6. A device as claimed in Claim 5, in which the mounting portion of the extension is joined to the bowed portion by an outwardly cranked portion to provide a clearance for the usual stop ring on the casing.

7. A device as claimed in any of the preceding claims, in which the end rings comprise separable halves or portions.

8. A device as claimed in Claim 7, in which the separable portions are provided with inter-engageable hinge parts which are connected by pins.

9. The improved centralizing device for bore hole casing substantially as hereinbefore described with reference to the accompanying drawing.

MARKS & CLERK.

PROVISIONAL SPECIFICATION.

Improvements in and relating to Devices for Centralizing Casing in Boreholes.

I, ALBERT EDWARD ATKINSON, a British Subject of Ditton Edge, 108, Manor Road North, Hinchley Wood, Esher, in the County of Surrey, do hereby declare the nature of this invention to be as follows:—

This invention relates to devices for centralizing casing in boreholes in conjunction with well drilling and like operations, of the kind comprising an annular series of bowed springs secured at their ends to spaced rings which are adapted to be fitted to the exterior of the casing so that the bowed portions of the springs can engage the wall of the borehole. The main purpose of such devices is to ensure that the casing occupies a position at or near the centre of the borehole for the introduction of cement between the casing and the wall of the hole. The casing is liable to be subjected to considerable side thrust, for example if the hole is not straight or has a sinuous form and such may be sufficient to flatten the springs on one side of the casing so that the latter will be eccentrically disposed in the hole. Since the clearance between the wall of the hole and the casing is small, there is a limit to the dimensions of the springs which can be employed and such are usually of standard sizes. It is the object of the present invention to provide an improved device capable of centralizing casing under greater side thrusts than has hitherto been possible, and without substantially increasing the spring dimensions. A further object is to provide a simple, convenient and relatively inexpensive construction which fulfills the above requirements.

The invention comprises connecting the bowed springs to the end rings in such a manner that the bowed spring portions can be initially stressed to increase their resistance to lateral load.

The invention also comprises forming or providing the bowed springs, at one or both ends, with a mounting extension which in the free condition of the spring occupies a position displaced from its working position

on the end ring, so that when in working position, the bowed portion of the spring is initially stressed to increase its resistance to lateral load. Preferably such displaced extensions are provided at both ends of each spring.

The invention further comprises providing a connection between the spring end extensions and the end rings including a lug or angled portion on the spring extension engaged in an aperture or between abutments on the ring so that individual relative movement in the longitudinal direction of the device is prevented.

According to a further feature of the invention, the springs comprise a bowed portion and an integral extension at one or both ends which is displaced in the free condition of the spring as previously described and is adapted to be mounted in the end ring so as to stress the spring when the device is applied to the casing. The mounting portion of the extension may be joined to the bowed portion by an outwardly cranked portion to provide a convenient clearance for the usual stop ring secured to the casing and against which the end ring of the device abuts when the casing is displaced in the borehole.

In carrying the invention into effect according to one convenient mode applied to a centralizing device of the kind described, each of the steel springs is formed with a bowed portion having integral end extensions adapted to be connected to the end rings and which extensions, in the free condition of the spring, are relatively inclined in such a manner that when brought into alignment when the rings are mounted on the casing, the bowed portion is stressed to increase its resistance to applied load. Each extension comprises a straight portion adapted to be connected to the ring and joined to the bowed portion by an outwardly cranked portion. The ends of the straight portions are turned outwardly to form lugs which are adapted to enter correspondingly shaped slots in the end rings of the device. These end rings may be formed in any convenient way to receive the spring extensions, the arrangement being such that when the springs are connected to the rings and the device is mounted on the casing, the aforesaid extensions are forcibly brought into alignment or into a position parallel with the longitudinal axis of the device so that the bowed portion is stressed outwardly, and the lugs on the ends of the springs enter the ring slots and thereby prevent relative longitudinal movement of the individual springs. A convenient form of ring may be built up from curved sections by welding or in any other suitable manner. Each ring comprises an inner series of curved sections uniformly spaced so that the ends of the springs may enter between them. These sections are connected by an outer series of curved sections which overlap and bridge the inner sections to which they are welded or otherwise secured, each of said outer sections having a transverse slot to receive the spring lug. The sections may be formed from suitably curved plate and the inner sections may be longer in the direction of the ring axis than the outer sections. A ring built up in this manner will have a castellated cross-section and affords the advantage of a somewhat larger area for fluid flow outside the casing.

The arrangement is such that when the springs are assembled in the rings as described above and the rings are mounted on the casing, each spring bow is initially stressed outwardly by the displacement of its extensions into alignment or into a position approaching alignment, this displacement being effected by the engagement of the inner ends of the extensions (or the outer ends of the bow portion) with the casing to force such portions or the springs apart, and since the outer ends of the spring extensions are held within the rings, this displacement increases the bowing of the spring and affords it initial stress. It will be seen that, in effect, the ends of the bow constitute fulcrums and the extensions act as levers to apply the initial stress, as a result of which the spring bows are capable of resisting a considerably greater load than in their free condition, not only when the load is first applied, but throughout the range of deflection of the bow. Also the mode of connecting the springs to the end rings prevents relative longitudinal motion between the springs and rings, so that no spring can act individually should it alone be subject to stress in passing a kink or obstruction in the hole, such spring being afforded the collective resistance of all the springs in resisting elongation by flattening. The cranked portions at the end of the spring bows afford a convenient clearance for the usual stop rings which are secured to the casing within the end rings of the centralizing device.

Any desired number of springs may be provided, the number generally varying in accordance with the casing diameter. The springs are generally disposed to lie parallel with the axis of the casing, but they may be inclined thereto if desired. The invention is not restricted to the mode of connecting the springs to the ring nor to the ring construction described in the above example. Thus in an alternative arrangment, the springs may be permanently secured to the rings in such a manner as

to afford the required initial set of the bowed spring portions.

Dated this 15th day of December, 1949.

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Abingdon: Printed for His Majesty's Stationery Office, by Burgess & Son (Abingdon), Ltd.—1951
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies, price 2s. per copy; by post 2s. 1d. may be obtained.

Fig. 1.

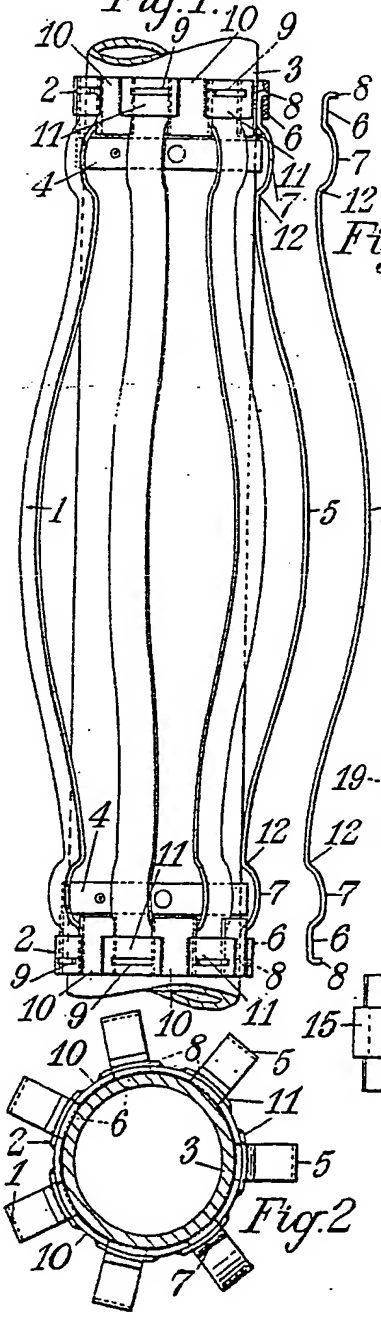

Fig. 1a.

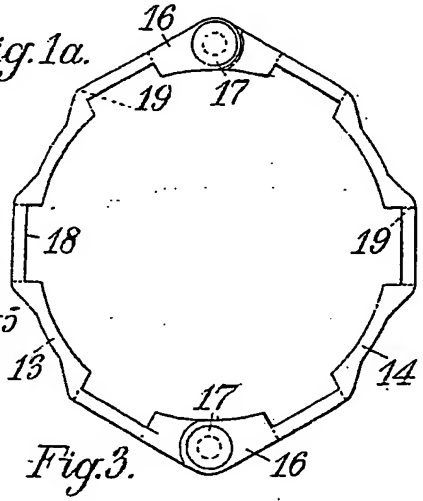

Fig. 3.

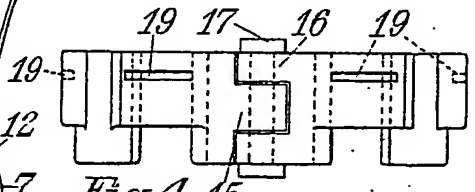

Fig. 4.

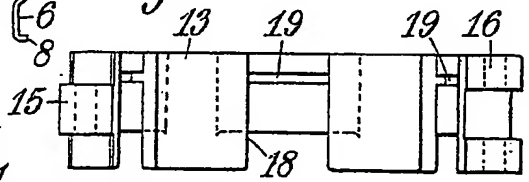

Fig. 5.

Fig. 2